



National Oceanic & Atmospheric
Administration (NOAA)
Office of Space Commerce (OSC)



Traffic Coordination System for Space (TraCSS)

Specifications on Orbit Mean-
Elements Message Data
Format for Traffic
Coordination System for
Space (TraCSS)

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1. Purpose

This document provides the space situational awareness (SSA) community with the specifications on the format for orbit characteristic data for the Department of Commerce (DOC) Traffic Coordination System for Space (TraCSS). TraCSS proposes to use the Consultative Committee for Space Data Systems (CCSDS) recommended orbit mean-elements message (OMM) state format as detailed in the CCSDS Orbit Data Messages (ODM) recommended standard¹. The ODM specifies message formats for use in transferring spacecraft orbit information between space agencies and commercial or governmental spacecraft operators. The current issue, April 2023, includes the OMM.

In this document, DOC provides some constraints on the fields and implementation of the OMM as necessary to meet the needs of TraCSS.

2. Background

2.1. Consultative Committee for Space Data Systems

The Consultative Committee for Space Data Systems (CCSDS)² is a multi-national organization of international space agencies that develops open communications and data standards for space systems. The standards are available through the International Organization for Standardization (ISO) Technical Committee 20, Aircraft and Space Vehicles, Subcommittee 13, Space Data and Information Transfer Systems, and at the CCSDS website.

2.2. Orbit Mean-Elements Message

As described in the ODM Recommended Standard (see reference in footnote 1), an OMM contains the orbital characteristics of a single object at a specified epoch, expressed in mean Keplerian elements: mean motion, eccentricity, inclination, right ascension of ascending node, argument of perigee, and mean anomaly. In addition, the OMM contains values for parameters that facilitate the modeling of non-conservative forces for various mean element theories.

The OMM is suited to exchanges that (1) involve automated interaction and/or human interaction, and (2) do not require high-fidelity dynamic modeling. The message is suited for directing antennas and planning contacts with satellites. It is not recommended for assessing mutual physical or electromagnetic interference among Earth-orbiting spacecraft, developing collaborative maneuvers, or propagating precisely

¹ Orbit Data Messages. Issue 3. Recommendation for Space Data System Standards (Blue Book), CCSDS 502.0-B-3. Washington, D.C.: CCSDS, April 2023. Available at: Orbit Data Messages

² Visit [CCSDS.org](https://www.ccsds.org) for more information on the CCSDS.

the orbits of active satellites, inactive man-made objects, and near-Earth debris fragments. It is not suitable for numerical integration of the governing equations.

3. Specifications for the TraCSS Orbit Mean-Elements Message

The OMM will be a supplementary product that TraCSS will deliver for describing the orbital state of an object based on mean orbital elements for a specified epoch. Table 1 is a comprehensive reference of the fields to be included in a TraCSS OMM.

TraCSS will present OMMs in KVN as outlined in the CCSDS Recommended Standard. TraCSS will also present OMMs in JavaScript Object Notation (JSON).

Value fields consisting of UTC timestamps will be in the ISO 8601 format YYYY-MM-DDThh:mm:ss.sss, where ‘YYYY’ is the year; ‘MM’ is the two-digit month; ‘DD’ is the two-digit day; ‘T’ is constant; and ‘hh:mm:ss.sss’ is the time in hours, minutes, seconds and fractional seconds.

3.1. Alpha-5 Schema

NORAD catalog numbering permits integer object IDs up to nine digits. However, traditional two- or three-line element sets (TLEs) have fixed width and only reserve five characters for an object’s numerical identifier. This limits the range of objects describable with TLEs to those with catalog number below 100,000.

For objects with catalog number above 99,999, the Alpha-5 schema converts the numeric catalog number with an alphanumeric one. The schema replaces the first two digits with a capital letter A–Z (excluding the letters “I” and “O” to avoid confusion with the numbers “1” and “0”). This encoding extends the range of objects representable with five characters to those with a numeric ID below 340,000.

In TLE lines, TraCSS will use the Alpha-5 schema to represent object catalog numbers 100,000–339,999. Values in the `NORAD_CAT_ID` field will be represented with integers up to nine digits.

Table 1: The total list of fields in a TraCSS OMM

Keyword	Description	Example(s) of Values
CCSDS_OMM_VERS	OMM format version in the form X.Y, where Y is incremented for corrections and minor changes, and X is incremented for major changes.	3.0
CLASSIFICATION	Description of classification/dissemination controls of this OMM.	UNCLASSIFIED. Operator- proprietary data; secondary distribution not permitted.

CREATION_DATE	UTC timestamp representing file creation date/time.	2025-03-25T02:12:31
ORIGINATOR	Creating agency or operator.	TraCSS
MESSAGE_ID	ID that uniquely identifies a message from the originator.	OMM 202502083579
OBJECT_NAME	The common name for the spacecraft for which mean element orbit data are provided. If the content is unknown or cannot be disclosed, a value of UNKNOWN will be used.	STARLINK-1036 SL-14 DEB UNKNOWN
OBJECT_ID	The International Designator of the object for which mean element orbit data are provided. Format is YYYY-DDDXXX, denoting the year and serial number of launch (with leading zeros), followed by at least one capital letter to discern objects of the same launch.	1998-006A 2020-012BD UNKNOWN
CENTER_NAME	Origin of the OMM reference frame. NOTE – TraCSS will restrict this field to ‘EARTH’.	EARTH
REF_FRAME	Reference frame in which the Keplerian element data are given.	TEME
TIME_SYSTEM	Time system used for Keplerian element data. NOTE – TraCSS will restrict this field to ‘UTC’.	UTC
MEAN_ELEMENT_THEORY	Description of the Mean Element Theory. Indicates the proper method to employ for state propagation.	SGP4
Keyword	Description	Units
Mean Keplerian elements in the specified reference frame.		

EPOCH	UTC timestamp representing the epoch at which Mean Keplerian element values are defined.	
MEAN_MOTION	Mean motion.	rev/day
ECCENTRICITY	Eccentricity.	
INCLINATION	Inclination.	deg
RA_OF_ASC_NODE	Right ascension of the ascending node.	deg
ARG_OF_PERICENTER	Argument of pericenter.	deg
MEAN_ANOMALY	Mean anomaly.	deg
TLE related parameters.		
EPHEMERIS_TYPE	0 = SGP (default value) 2 = SGP4 3 = PPT3 4 = SGP4-XP 6 = Special Perturbations	
NORAD_CAT_ID	NORAD Catalog Number; an integer of up to nine digits.	
ELEMENT_SET_NO	Element set number for this object. Used to distinguish different TLEs.	
REV_AT_EPOCH	Revolution number.	
BSTAR	Drag-like ballistic coefficient.	1/[Earth radii]
MEAN_MOTION_DOT	First time derivative of the mean motion (i.e., a drag term).	rev/day**2
MEAN_MOTION_DDOT	Second time derivative of mean motion (i.e., a drag term).	rev/day**3
USER_DEFINED_SEMI MAJOR_AXIS	Semi-major axis.	km
USER_DEFINED_PERI OD	Orbital period.	min
USER_DEFINED_APOA PSIS	Apoapsis altitude.	km
USER_DEFINED_PERI APSIS	Periapsis altitude.	km

USER_DEFINED_OBJECT_TYPE	Type of object (PAYLOAD, ROCKET BODY, DEBRIS, or UNKNOWN).	
USER_DEFINED_RCS_SIZE	Radar cross section size (SMALL, MEDIUM, or LARGE).	
USER_DEFINED_COUNTRY_CODE	Two-letter code for country of origin.	
USER_DEFINED_LAUNCH_DATE	Launch date in YYYY-MM-DD.	
USER_DEFINED_SITE	Launch site.	
USER_DEFINED_DECAY_DATE	Decay date in YYYY-MM-DD.	
USER_DEFINED_TLE_LINE0	Title line of TLE for this object.	
USER_DEFINED_TLE_LINE1	Line 1 of a TLE for this object.	
USER_DEFINED_TLE_LINE2	Line 2 of a TLE for this object.	